MICROSCOPE HAVING AN ILLUMINATION SYSTEM

CROSS REFERENCE TO RELATED APPLICATIONS

[0001] This application claims priority of the German patent application 103 03 825.6 filed January 31, 2003 which is incorporated by reference herein.

FIELD OF THE INVENTION

[0002] The invention concerns a microscope having an illumination system. The invention deals in particular with fluorescence illumination system (UV illumination system) for a stereomicroscope. "Fluorescence illumination" is understood to mean illumination by means of a light in the ultraviolet wavelength region, resulting in expanded observation and analysis capabilities with so-called fluorescence observation of the specimen being viewed.

BACKGROUND OF THE INVENTION

[0003] Those skilled in the art are familiar principally with UV illumination units that are arranged laterally and obliquely on the microscope body, or above it. The substantial disadvantages of such arrangements are, however, that such illumination units require a great deal of space, and further that the illumination occurs obliquely – in any event not coaxially with the main beam path or paths of the microscope (corresponding to the optical axis of the microscope) – and thus produces an inhomogeneous illumination field that forms "shadows."

[0004] Illumination units that are reflected in sideways, by means of deflection elements positioned beneath the main objective, have therefore been created. Thanks to good coaxial alignment with the main beam path of the microscope, these arrangements are capable of yielding a homogeneously illuminated viewing field. A disadvantage here, however, is that the working distance – i.e. the distance between the lowest part of the microscope and the specimen – is unacceptably reduced by the space occupied by the laterally arranged illumination units and most of all by the deflection elements beneath the main objective.

[0005] A solution that is improved in this regard has already been presented in DE-A1-197 39 428. Here the deflection of the illuminating beam path is accomplished by means of a deflection mirror that is arranged above or at the level of the main objective, and that directs the illumination beam through an opening in the main objective. A "meniscus" (i.e. an additional optical element having positive focal power) and a filter are provided below the main objective in a manner allowing them to be pivoted in. This makes possible approximately coaxial illumination with less of a negative influence on the working distance. The disadvantages that remain, however, are the complex embodiment of the main objective and an illumination that is still one-sided, with the possibility of shadowing.

SUMMARY OF THE INVENTION

[0006] The object that presented itself to the inventor was therefore that of discovering an improved UV illumination system that no longer exhibits the aforesaid disadvantages. The new type of illumination was also intended to be usable in the same way for other light sources, and to provide improvements in that context as well.

[0007] This object is achieved by the use of two illumination beam paths that are directed through a combined deflection element of a conventional illumination system. For this, two deflection elements are mounted laterally (preferably symmetrically) on the deflection prism of the normal coaxial illumination system. The advantage of a conventional coaxial illumination is thus retained, without reducing the working distance. In addition, the provision of two additional illumination beam paths guarantees not only stronger illumination, but also substantially more homogeneous illumination. This is based on the fact that good coaxiality of all the illumination beams with respect to the optical axis of the microscope is implemented, and additionally that for each pupil a separate illumination beam (i.e. preferably the respective oppositely located one) is available at an optimum return angle. This is optimized when the two illumination beam paths are arranged symmetrically.

[0008] The two deflection elements arranged, preferably symmetrically, on the deflection prism of a conventional illumination system can be mirrors or prisms having a mirror-coated cemented surface. The mirrors can be a plane mirror or also a concave mirror having refractive (focal) power. The prisms can be simple prisms without refractive power. They can also comprise one or more surfaces having refractive power.

[0009] In the preferred embodiments of the deflection element as an optical element having refractive power, the deflection element acts as a field lens that makes possible imaging of a field diaphragm of the UV illumination system by the main objective. Better delimitation of the illuminated field on the specimen is thereby achieved (Köhler illumination).

[0010] In addition, however, those variant embodiments of the invention in which the deflection elements themselves have no refractive power also fall within the disclosure context of the Application. In this case the objective and/or other additional optical elements ensure optimum projection into the object plane.

[0011] In a preferred embodiment, the angle between the optical axis of the main illumination and that of the laterally arranged illumination beam paths is approximately 90 degrees; other arrangements are, however, likewise within the context of the disclosure of this Application.

[0012] Light sources for purposes of this Application may also be individual light guides or fiber bundles or individual fibers that originally derive from a single illumination source, since the multiple introduction locations of the light are essential to the invention.

[0013] Further embodiments of the invention are described in the Figures and in the dependent claims. The Parts List is a constituent of the disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014] The invention will be described in more detail, symbolically and by way of example, with reference to schematic Figures. The Figures are described in continuous and overlapping fashion. Identical reference characters denote identical

components; reference characters having different indices indicate functionally identical components. In the drawings:

FIG. 1a shows in plan view the configuration of a known illumination device for a stereomicroscope;

FIG. 1b shows the configuration of FIG. 1a in a side view;

FIG. 2a shows in plan view a configuration according to the present invention, having a combined deflection arrangement and two lateral UV illumination arrangements;

FIG. 2b shows the arrangement of FIG. 2a in a side view;

FIG. 2c shows the arrangement of FIGS. 2a and 2b as viewed from the direction of light source 2, the deflection elements being depicted larger, and mirrors being used as deflection elements; and

FIG. 3 shows the arrangement of FIGS. 2a and 2b as viewed from the direction of light source 2, prisms being arranged as deflection elements instead of the mirrors.

DETAILED DESCRIPTION OF THE INVENTION

[0015] FIGS. 1a and 1b depict the configuration of an illumination apparatus for a stereomicroscope in order to illustrate the existing art, a microscope body 1 being depicted in plan view and in section. It is apparent that microscope body 1 is separated by partition 15a into a part in which microscope pupils 6a and 6b are arranged, and a part where deflection prism 5 is arranged. The illumination beam path, depicted by optical axis 3, is generated by light source 2, and an image of field diaphragm 4 is projected by means of deflection prism 5 and main objective ensemble 13 onto object field 9.

[0016] It is evident that for the purpose of better definition of the illuminated field, deflection prism 5 is equipped with refractive power. As a result, deflection element 5 acts as a field lens that allows field diaphragm 4 to be imaged by main objective ensemble 13. The illumination beam path, represented by optical axis 3, is aligned onto the center of object field 9, which at the same time lies on the optical axis of main objective ensemble 13. From there, the illumination beam path

(represented by optical axis 3) is received by the observation beam path (represented by optical axis 8 of the microscope) and guided through microscope pupils 6a and 6b (no longer depicted).

[0017] FIG. 2a shows manner in which a UV illumination arrangement according to the present invention is constructed. Provided here, in addition to the conventional illumination system as shown in FIGS. 1a and 1b, are two laterally arranged illumination systems 16a and 16b from which the non-UV wavelength region is blocked by means of filters 14a and 14b, respectively. The UV illumination beam path thereby produced – represented by optical axes 10a and 10b, respectively – passes through the respective iris diaphragms 11a and 11b and is deflected by respective deflection elements 12a and 12b onto object field 9 (not depicted in this view).

[0018] FIG. 2b is a side view of the configuration presented in FIG. 2a, and does not depict the laterally arranged UV illumination systems 16. For better elucidation, the corresponding beam paths 10a and 10b are depicted next to one another, although they are collimated and (in this side view) superimposed on one another.

[0019] FIG. 2c is a view, rotated 90 degrees to the right, of the configuration shown in FIG. 2b; in other words, the configuration is viewed from the direction of optical axis 3 of illumination device 19 (not depicted here) with normal illumination. It is evident here that deflection elements 17a and 17b are embodied symmetrically as mirrors for the deflection of beam paths 10a and 10b of UV illumination devices 20a and 20b, respectively. It is also evident from this viewing angle that right-hand illumination beam path 10a, constituting reflected observation beam path 10a', can optimally coaxially supply the oppositely located microscope pupil 6b (not depictable here; cf. FIG. 2a). The same is true, vice versa, of illumination beam path 10b. As a result of their shape that is clipped for space reasons, the deflection elements have an extension similar to that of a pyramid.

[0020] FIG. 3 presents a variant embodiment with prisms 18a, b having refractive power, and consequently also with iris diaphragms 11a, b.

[0021] The present invention can also be embodied in a microscope having transmitted specimen illumination, wherein the deflection elements and illumination

beam paths are arranged below a specimen carrier of the microscope such that the illumination beams travel upward and light is transmitted through the specimen to the microscope objective.

PARTS LIST

1	Microscope body
2	Light source for conventional illumination
3	Optical axis of conventional illumination
4	Field diaphragm for conventional illumination
5	Deflection prism having refractive power
6a, b	Microscope pupil(s)
7	Optical axis of main objective
8	Optical axis of microscope
9	Object field
10a, b	Optical axis/axes of UV illumination
10a', b'	Optical axis/axes of reflected observation beam path
11a, b	Iris diaphragm(s)
12a, b	Deflection element(s)
13	Main objective ensemble
14a, b	Filter(s)
15a, b	Partition(s)
16a, b	UV illumination light source(s)
17a, b	Mirror(s)
18a, b	Prism(s) having refractive power
19	Illumination device for conventional illumination
20a, b	UV illumination device(s)
21	Composite deflection element